TEK

Instruction Manual

GP-IB Interface for Model 2533E Digital Power Meter

IM 2533E-51E

MP MASTER
MA33144

YOKOGAWA
Yokogawa Electric Corporation

IM 2533E-51E
1st Edition

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1. OUTLINE

1-1. General

2533E is a multi-function power meter which measures, in a single unit, not only voltage, current and effective power but also reactive power, apparent power and power factor. Optionally, a watt-hour (Wh), current capacity (Ah) or frequency measuring function can be incorporated.

For remote programming, the GP-IB interface is available. Using a GP-IB controller, remote control and data output can be performed, thereby making it possible to use the instrument as a component in an automatic measuring system used in a research laboratories or production lines.

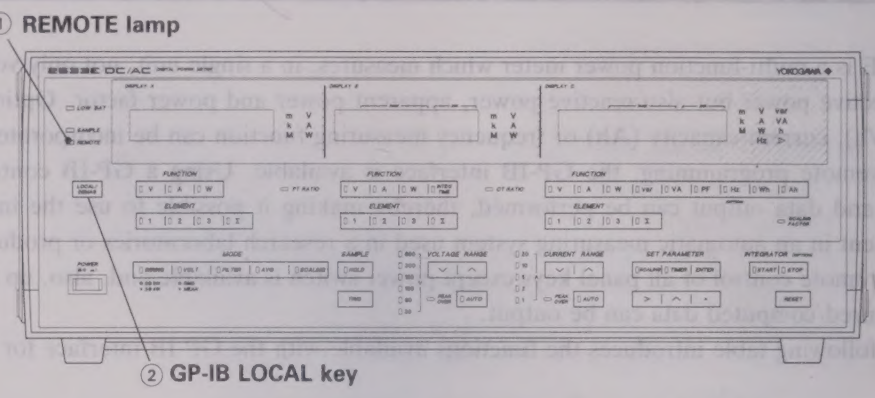
Full remote control of all panel keys except power switch is available and, also, up to three items of measured/computed data can be output.

The following table introduces the functions available with the GP-IB interface for 2533E.

Mode		Function
Addressable mode	Listener function	Voltage, current range setting Digital display selection Measurement mode designation Scaling factor setting Integrating function (option) control
	Talker function	Measured/computed data output Setting information output Error code output Status byte output Integrated value output
Talk only mode	Talker function	Measured/computed data output

1-2. Designations and Functions

<Front view of 2533E>



① REMOTE lamp

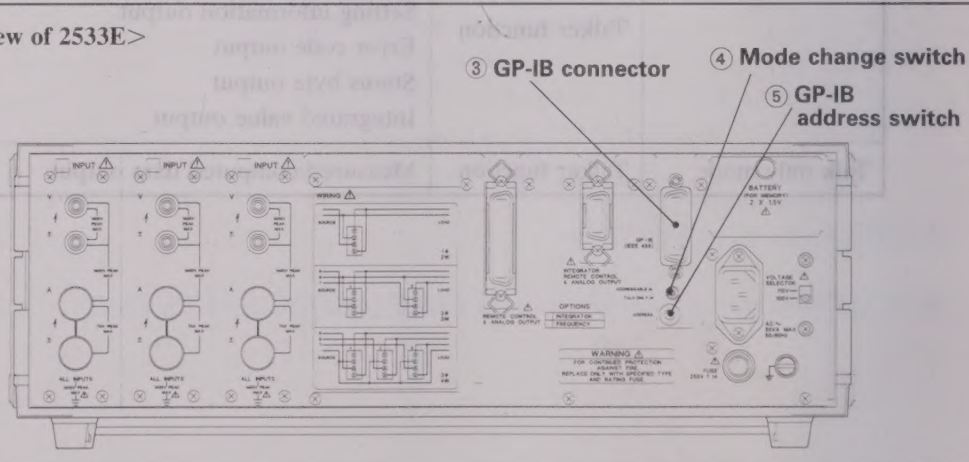
Comes on when the 2533E is addressed by GP-IB interface.

In remote status, the front panel keys except [LOCAL] key are locked out.

② GP-IB LOCAL key

For manually canceling a remote state (return the instrument to local). It is overridden when LOCAL LOCKOUT is sent by GP-IB controller.

<Rear view of 2533E>



③ GP-IB connector

Changes the 2533E to ADDRESSABLE mode or TALK ONLY mode. As viewed from the rear of 2533E, ADDRESSABLE mode is on the right and TALK ONLY mode is on the left.

④ Mode change switch

Changes the 2533E to ADDRESSABLE mode or TALK ONLY mode. As viewed from the rear of 2533E, ADDRESSABLE mode is on the right and TALK ONLY mode is on the left.

- **The instrument is factory set at ADDRESSABLE mode.**
- **Change the mode with power OFF.**

⑤ GP-IB address switch

Sets the GP-IB address of 2533E. The address is settable within the range of 0 to 15. Set 10 to 15 as 10→A, 11→B, 12→C, 13→D, 14→E and 15→F.

- **The address is 1 as factory set.**
- **Set the address with power OFF.**

The front and rear views of the instrument are represented by triple-phase 4-wire model 2533E-43. The sections related to GP-IB are common to other models.

1-3. Specifications

Electrical and mechanical specifications: conform to IEEE St'd 488-1978
Functional specifications: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0
Code used: ISO (ASCII) code
Address setting: talker/listener addresses 0 to 15 are settable by select switch
Remote status cancel: can be canceled by pressing GP-IB LOCAL key on panel (overridden with LOCAL LOCKOUT by controller)

FUNCTION	Description
SH 1	All send handshake functions provided
AH 1	All receive handshake functions provided
T 5	Basic talker function, serial poll function, talk only function, talker cancel function by MLA (My Listen Address) provided
L 4	Basic listener function, listener cancel function by MTA (My Talk Address) provided
SR 1	All service request functions provided
RL 1	All remote/local functions provided
PP 0	Parallel poll function not provided
DC 1	All device clear functions provided
DT 1	All device trigger functions provided
C 0	Controller function not provided

Accessories: 1 copy instruction manuals IM 2533E-50E

<Answer to Interface Message>

Answer to interface message is shown below.

(1) SDC (Selected Device Clear), DCL (Device Clear)

- The same as when power is turned on, the 2533E is initialized except the interface section. Battery-backed-up function, range and other data and parameters are held even when this message is received. Non-battery-backed-up interrupt mask/delimiter setting, measured data other than integrated data and integration modes are reset.

(2) GET (Group Execute Trigger)

- A-D conversion is started when 2533E is in a sample hold status.
  The function is the same as ST command (☛ page 2-8).

<Operation When Changing over between Remote and Local>

(1)When changing from local to remote

Panel setting statuses in local are held when it is changed to remote.

(2)When changing from remote to local

The panel setting statuses in remote are held when it is changed to local.

1-3. Specifications

2. LISTENER FUNCTIONS

2-1. On Listener Functions

The listener function of 2533E can remote by control all available functions corresponding to keys on the front panel of the 2533E except power switch ON/OFF control.

It is also possible to output (talker function) data by receiving (listener function) data measured or computed data output command or error code/setting information output command.

When designated as a listener, a specified operation is carried out by program data sent from the talker when ATN=F (False).

The program data consist of a command, parameter and terminator and are set by means of ASCII code.

<Command>	<Parameter>	<Terminator>
RA	ℓ	{ C_R L_F / L_F / ; } * EOI

* When using EOI as a terminator, set True when sending the last character of terminator.

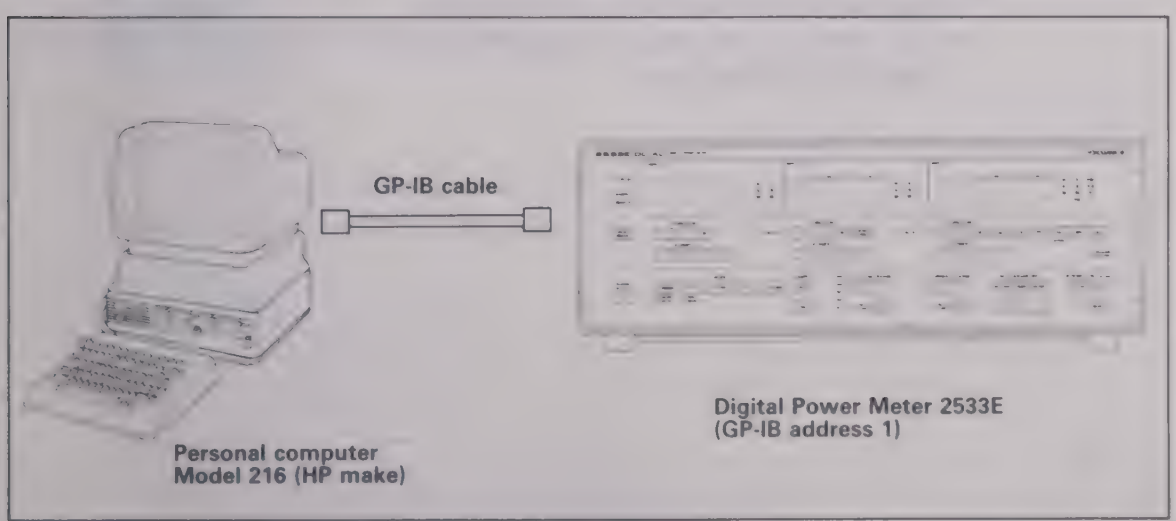
Symbol handling and meaning

C_R	: carriage return
L_F	: line feed
;	: semicolon
{ }	: select one

Command ; defined by 2 capital upper-case alphabetical characters.
(for meaning, see each command).

Pamameter ; numerical ASCII code

The sample program shown below has been created by Model 216 (HP make). GP-IB address of this instrument is "1" the same as factory set.



2-2. Program Data

2-2-1. Setting Voltage and Current ranges (RANGE)

AV (Auto Voltage range)

AA (Auto current (A) range)

Function Designates whether to set the voltage and current ranges to automatic range setting mode or fixed range mode.

Syntax
AV ℓ <terminator>
AA ℓ <terminator> ℓ=0, 1

Comment
- Fixed range mode when ℓ=0. The key lamp is extinguished.
- Automatic range setting mode when ℓ=1. The key lamp is lit.
- When ℓ is not set or is set to 2 or higher value, a syntax error occurs and the range mode does not change and is ignored. Error number is 101.
- The default value is ℓ=0 (fixed range mode). When battery backed-up, settings in local mode defaults to initial value.
- This function corresponds to [AUTO] key operation in local mode.

RV (set Range Voltage)

Function A voltage range is set in a fixed range mode.

Syntax RV ℓ <terminator> ℓ=4 to 9

Comment
- Effective in a fixed range mode and ignored in an automatic range setting mode (syntax error does not occur). It is recommended to combine with AV0 command.
- The meaning of ℓ is as follows. The lamp of a set voltage range comes on.
  RV 4 ..... 30 V range RV 7 ..... 150 V range
  RV 5 ..... 60 V range RV 8 ..... 300 V range
  RV 6 ..... 100 V range RV 9 ..... 600 V range
- When ℓ is set to 3 or less or 10 or more, a syntax error occurs, and the range setting does not change but is ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of [∨], [∧] key of VOLTAGE RANGE (V) in local mode.

RA (set Range current (A))

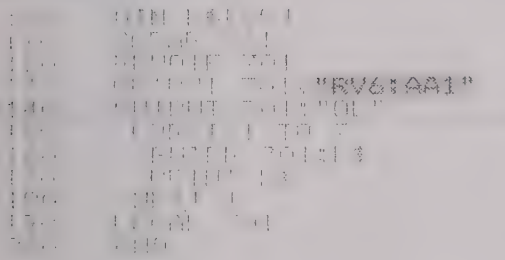
Function A current range is set in a fixed range mode.

Syntax RA ℓ <terminator> ℓ=4 to 9 (AC model)
5 to 9 (DC/AC model)

Comment

- Effective in a fixed range mode and ignored in an automatic range setting mode (no syntax error occurs). It is recommended to combine with AA0 command.
- The meaning of ℓ is as follows. The lamp of a set current range comes on.
  RA 4 ..... 0.5 A range* RA 7 ..... 5 A range
  RA 5 ..... 1 A range RA 8 ..... 10 A range
  RA 6 ..... 2 A range RA 9 ..... 20 A range
  * Only for AC model. (If 0.5 A range is set in DC/AC model, a syntax error occurs.)
- When ℓ is set to 3 or less or 10 or more, a syntax error occurs, and the range setting does not change but ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of [∨] or [∧] key of CURRENT RANGE (A) in local mode.

Sample Program



<Model 216 read data (setting information)>

2-2-2. Selecting digital display (DISPLAY)

DA, DB, DC (set Display A, B, C function)

Function Selects FUNCTION of digital display on DISPLAY A, DISPLAY B and DISPLAY C.

Syntax
DA ℓ <terminator> ℓ=1 to 3
DB m <terminator> m=1 to 4
DC n <terminator> n=1 to 10

Comment
- The meaning of ℓ, m and n is as follows.

Parameter ℓ, m, n	DAℓ	DBm	DCn
1	V (voltage) display	V (voltage) display	V (voltage) display
2	A (current) display	A (current) display	A (current) display
3	W (effective power) display	W (effective power) display	W (effective power) display
4	—	INTEG TIME (integration time) display	var (reactive power) display
5	—	—	VA (apparent power) display
6	—	—	PF (power factor) display
7	—	—	Hz (V1) (voltage frequency) display
8	—	—	Hz (A1) (current frequency) display
9	—	—	Wh (watthour) display
10	—	—	Ah display

EA, EB, EC (set Element A, B, C)

Function Selects ELEMENTS of digital displays on DISPLAY A, DISPLAY B and DISPLAY C.

Syntax
EA ℓ <terminator>
EB ℓ <terminator>
EC ℓ <terminator> ℓ=1 to 4

Comment The meaning of ℓ is as follows.

ℓ=1 ····· ELEMENT 1

ℓ=2 ····· ELEMENT 2

ℓ=3 ····· ELEMENT 3

ℓ=4 ····· ELEMENT Σ

- Ineffective on single phase models 2533E-31 and 2533E-41.
- ℓ=2 is ineffective on triple-phase 3-wire models 2533E-33 and 2533E-43.

Sample program

```
10   DIM L$[80]
20   CLEAR
30   OUTPUT 701;"DA3:DB2:DC1"
40   OUTPUT 701;"OL"
50    FOR I=1 TO 7
60      ENTER 701;L$
70      PRINT L$
80    NEXT I
90   CALL 701
100  END
```

<Model 216 read data (setting information)>

```
DA3 :DB2 :DC1
                                    :BO:SC0:HD0
                                    :0:KW1.0000
                                    0
```

2-2-3. Designating measurement mode (MODE)

WR (WiRing mode)

Function Designates whether the triple-phase 4-wire models 2533E-33 and 2533E-43 is wired to triple-phase 3-wire or triple-phase 4-wire system.

Syntax WR ℓ <terminator> ℓ=0, 1

Comment
- Effective only for triple-phase 4-wire models 2533E-33 and 2533E-43.
- The meaning of ℓ is as follows.
  WR 0 is set when wired for triple phase 3-wire system.
  WR 1 is set when wired for triple phase 4-wire system.
- The function does not change over the wiring itself but changes over the analog summation input according to the wiring.
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs, and the setting mode does not change but is ignored. Error number is 101.
- This function corresponds to operation of [WIRING] WIRING key in local mode.
  ○ 3φ3W
  ● 3φ4W

MN (MeaN)

Function Designates whether the measured voltage is rms (RMS) or mean rectification (MEAN).

Syntax MN ℓ <terminator> ℓ=0, 1

Comment
- The meaning of ℓ is as follows.
  MN 0 ... RMS (lamp for [VOLT] key comes on)
  MN 1 ... MEAN (lamp for [VOLT] key goes off)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs, and the setting mode does not change but is ignored. Error number is 101.
- This function corresponds to operation of [VOLT] key in local mode.
  ○ RMS
  ● MEAN

FL (FiLter)

Function Change over the measurement response time (FILTER FAST 0.4 s/FILTER SLOW 2 s).

Syntax FL ℓ <terminator> ℓ=0, 1

Comment
- The meaning of ℓ is as follows.
  FL 0 ... FILTER FAST (lamp for [FILTER] key goes off)
  FL 1 ... FILTER SLOW (lamp for [FILTER] key comes on)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs, and the setting mode does not change but is ignored. Error number is 101.
- This function corresponds to operation of [FILTER] key in local mode.

AG (AveraGing)

Function Designates whether or not to subject voltage, current and power measurement to exponential averaging.

Syntax AG ℓ <terminator>

Comment

- The meaning of ℓ is as follows.

  AG 0 ... exponential averaging is not made (lamp for [AVG] key goes off)

  AG 1 ... exponential averaging is made (lamp for [AVG] key comes on)

- The local mode setting will be an initial setting.
- This function corresponds to operation of [AVG] key in local mode.

SC (SCaling)

Function Designates whether to display a measured value itself (SCALING OFF) or a product of measured value and scaling factor (SCALING ON).

Syntax SC ℓ <terminator> ℓ=0, 1

Comment

- The meaning of ℓ is as follows.
  SC 0 ... SCALING OFF (lamp for [SCALING] key goes off)

  SC 1 ... SCALING ON (lamp for [SCALING] key comes on)

- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs, and the setting mode does not change but is ignored. Error number is 101.
- This function corresponds to operation of [SCALING] key in local mode.

Sample Program

```
100
110
120
130                    "WR1;MN1;FL1;AG1;SC1"
140
150
160
170
180
190
200
```

<Model 216 read data (setting information)>

```
DA2 ;DB2 ;DC1
RV9;AV0
RA9;AA0
DS0;WR1;MN1;FL1;AG1;SC1;HD0
RV1.0000;RA1.0000;RW1.0000
TM00000
```

HD (sample HolD)

Function Designates whether sampling is allowed to run freely (approx. 2.5 samples s) or is held.

Syntax HD ℓ <terminator> ℓ=0,1

Comment

- The meaning of ℓ is as follows.

  HD 0 ... sampling free run (lamp for HOLD key goes off)

  HD 1 ... sampling hold (lamp for HOLD key comes on)

- When ℓ is not set or is set to 2 or more, a syntax error occurs, and the sampling mode does not change but is ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of HOLD key in local mode.

ST (STart)

Function At sampling hold, receiving ST command activates a measurement once, updates data displays and outputs data.

Syntax ST <terminator>

Comment

- Effective at sampling hold. Ignored at sampling free run. It is recommended to combine with HD 1 command.
- This function corresponds to operation of TRIG key in local mode.
- Receiving ST command in sampling free run mode causes a syntax error and outputs error code 107.
- Receiving ST command while data are being output (BUSY) with OL command or OE command causes a syntax error (page 2-10).

Sample Program

```
100   DIM D$[76]
110   CLEAR 701
120   REMOTE 701
130   OUTPUT 701;"[illegible]HD1"
140   OUTPUT 701;"ST"
[illegible]
[illegible]
170   LOCAL [illegible]
180   END
```

<Model 216 read data (measured data)>

```
DA1 FA1NV  . 00099.96E+0,DB2 EB1NA  . 000.3792E+0,DC3 EC1NW  . 00031.02E+0
```

DM (DeMag)

Function Demagnetizes DC-CT (current transformer) core.

Syntax DM <terminator>

Comment

- Used only for DC model.
- If a DM command is received, DC-CT core is demagnetized for about 5 seconds.
- During demagnetizing operation, A/D is stopped and commands other than OE command, and all keys are ignored.
- After demagnetizing, A/D end service request (SRQ) is generated. In a hold state, the measured and computated data are provided.
- This function corresponds to operation of DEMAG key operation in local mode.

<Note>

Demagnetization using DEMAG key is valid only in local mode. When a DM command is used, both remote and local modes are valid.

2-2-4. Setting Scaling (SCALING) factor

KA (K×Ampere)

KV (K×Voltage)

KW (K×Wattage)

Function Sets a scaling factor for a measured value of voltage, current or power.

Syntax

KV □□□□□□<terminator>
KA □□□□□□<terminator>
KW □□□□□□<terminator>
——Scaling factor

Comment

- The scaling factor setting range is 0.0001 to 10000. Setting is made by a string of 6 ASCII characters including a decimal point.
- When the specified setting range is exceeded or the number of digits is less than 5 or greater than 7, a syntax error occurs, and the scaling factor does not change but is ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of SET PARAMETER in local mode.

Sample Program

```
100   DIM L$[29]
110   CLEAR 701
120   REMOTE 701
130   OUTPUT 701;"KV20.000;KA1.0000;KW1.0000
140   OUTPUT 701;"SC1;OL
150    FOR I=1 TO
160     ENTER 701;L$
170     PRINT L$
180    NEXT I
```

<Model 216 read data (setting information)>

```
DA1 ;DB2 ;D07
EA1;EB1;EC1
RV5;AVC
R45;AR1
DSU;WR
KV20.0000;KA1.0000;KW1.0000
```

2-2-5. Setting information/error code output command

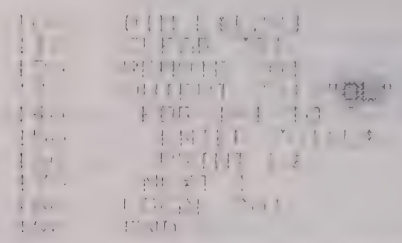
OL (Output List)

Function Outputs setting information.

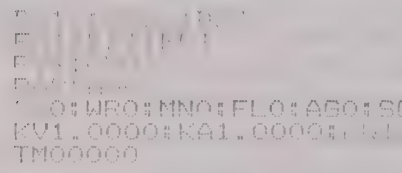
Syntax OL <terminator>

Comment
- Receiving OL command sets the information output mode. When GP-IB controller reads 7 lines of setting data, the digital display data output mode is resumed.

Sample Program



<Model 216 read data (setting information)>



<Note>

In sampling hold mode, after an error number or setting information is output with OE command or OL command, the control may be BUSY (message being output) for 400 ms maximum. If A-D conversion start is commanded by ST command or GET message while BUSY, a syntax error occurs, an error number 107 is output, and A-D conversion is not carried out.

To avoid this, send ST command or GET message at least 400 ms of wait time after reading an error number or setting information.

Sample Program

```
100   DIM J$[70]
110   CLEAR 701
120   REMOTE 701
130   OUTPUT 701;"HD1;OE"
140   ENTER 701;E$
150   PRINT E$
160   '
170   WAIT 1
180   '
190   OUTPUT 701;"ST"
200   ENTER 701;D$
210   PRINT D$
220   LOCAL 701
230   END
```

OE (Output Error code)

Function Outputs an error number

Syntax OE <terminator>

Comment
- When OE command is received, an error number output mode is posted. When GP-IB controller reads 1 line of error number, the digital display data output mode is resumed.
- When no error is produced, an error number 000 is output.
- When an error number is read, the error number becomes 000.

Error No.	Description	Operation of 2533E
000	No error (normal)	
100	Command error (undefined command is received)	• Service request SRQ is generated (syntax error) • "ERR 100" is sent when OE command is received
101	Parameter error • Parameter is beyond specified range • DISPLAY function (FUNCTION) and element (ELEMENT) are combined erroneously	• Service request SRQ is generated (syntax error) • "ERR 101" is sent when OE command is received • In case of erroneous combination of function and element, key lamps for designated function and element flash
102	Integration time is set during integration	
103	Result of scalling factor computation overflows from display digits.	• "(8)888888" appears on relevant display section • Service request SRQ is generated (OVER) • "ERR 103" is sent when OE command is received
104	Measured data overflow (input of A-D converter exceeds 140% of rated range)	• "999999" appears on relevant display section • Service request SRQ is generated (OVER) • "ERR 104" is sent when OE command is received
105	No measured data	• "(–)– – – – – –" appears on relevant display section • Service request SRQ is generated (OVER) • "ERR 105" is sent when OE command is received
106	Voltage peak value over (voltage peak value exceeds 250% of rated range)	• Voltage PEAK OVER lamp comes on • Service request SRQ is generated (OVER) • "ERR 106" is sent when OE command is received
107	While message (setting information, error No.) is being output, A-D conversion is started from GP-IB controller in sample HOLD mode or A-D conversion is started from GP-IB controller in sample free run mode	• Service request SRQ is generated (syntax error) • "ERR 107" is sent when OE command is received
108	Current peak value over (current peak value exceeds 350% of rated range)	• Current PEAK OVER lamp comes on • Service request SRQ is generated (OVER) • "ERR 108" is sent when OE command is received
200	A-D conversion time-out	• Program stop

<Note>

After error No. or setting information is output using OE command or OL command at sampling hold status, occasionally it turns to BUSY (where messages are output) for 400 ms at the longest. When A/D conversion start command is invoked using ST command or GET message during this BUSY period, a grammatical error occurs to output error No. 107 resulting in no A/D conversion.

To prevent occurrence of this phenomenon, never send ST command or GET message until 400 ms or more has elapsed after reading error No. or setting information.

2-2-6. Designating interrupt cause/delimiter

IM (Interrupt Mask)

Function Designates an interrupt cause for status byte.

Syntax IM ℓ <terminator> ℓ=2 to 30

Comment

- The meaning of ℓ is as follows.
  ℓ= 2 ... interrupt is generated when time-out (timer mode)/display overflow (manual mode) is produced with an optional integrating function
  ℓ= 4 ... interrupt is generated with A-D END
  ℓ= 8 ... interrupt is generated with a syntax error
  ℓ=16 ... interrupt is generated when measured or computed value overflows
  When it is desired to generate an interrupt with two or more causes, add the relevant values given above.
  Example: ℓ=12 Interrupt is generated by A-D END and syntax error (4+8).
- The initial value is ℓ=30.
- When unspecified interrupt is generated, its bit and RQS bit (DIO 7) do not become "1".
- Once a status byte is read by serial poll, the status byte is cleared.
- Integration BUSY cannot be invalidated (mask) by this command.

DIO 8	DIO 7	DIO 6	DIO 5	DIO 4	DIO 3	DIO 2	DIO 1
0	RQS	ERROR	OVER	Syntax ERROR	A-D END	Integration END	Integration BUSY
			16	8	4	2	

DS (Delimiter Set)

Function Designates timing for outputting EOI of delimiter.

Syntax DS ℓ <terminator> ℓ=0, 1

Comment The meaning of ℓ is as follows.

DS 0 ... when information output is set, EOI is generated only with the last byte (LF) of 7th line.

DS 1 ... when information output is set, EOI is generated by last byte (LF) at each line.

2-2-7. Operation control of integrating function (option)

IS (Integrate Start)

Function Start command for integrating function.

Syntax IS <terminator>

Comment
- Effective only for Model 2533E-□□/INTEG provided with integrating function.
- This function corresponds to operation of [START] key in local mode.

IP (Integrate stoP)

Function Stop command for integrating function.

Syntax IP <terminator>

Comment
- Effective only for Model 2533E-□□/INTEG provided with integrating function.
- This function corresponds to operation of [STOP] key in local mode.

IR (Integrate Reset)

Function Reset command for integrating function.

Syntax IR <terminator>

Comment
- Effective only for Model 2533E-□□/INTEG provided with integrating function.
- This function corresponds to operation of [RESET] key in local mode.

TM (set integrate TiMer)

Function Designates manual mode/timer mode and sets integration time.

Syntax TM $h_{100}h_{10}h_1m_{10}m_1$ <terminator> $h_{100}h_{10}h_1m_{10}m_1$=00000 to 10000

Comment
- Effective only for Model 2533E-□□/INTEG provided with integrating function.
- Manual mode ..... $h_{100}h_{10}h_1m_{10}m_1$=00000.
- Timer mode ..... $h_{100}h_{10}h_1m_{10}m_1$=00001 to 10000 (1 min to 100 h)
- When the setting time is beyond the specified range (more than 10000), a syntax error (101) occurs.
- When the integration mode is not set, or scaling or integration time was already set, do not set integration time again. Otherwise a syntax error (107) occurs.

OI (Output Integrate data)

Function Outputs the integrated value when a time-out occurs.

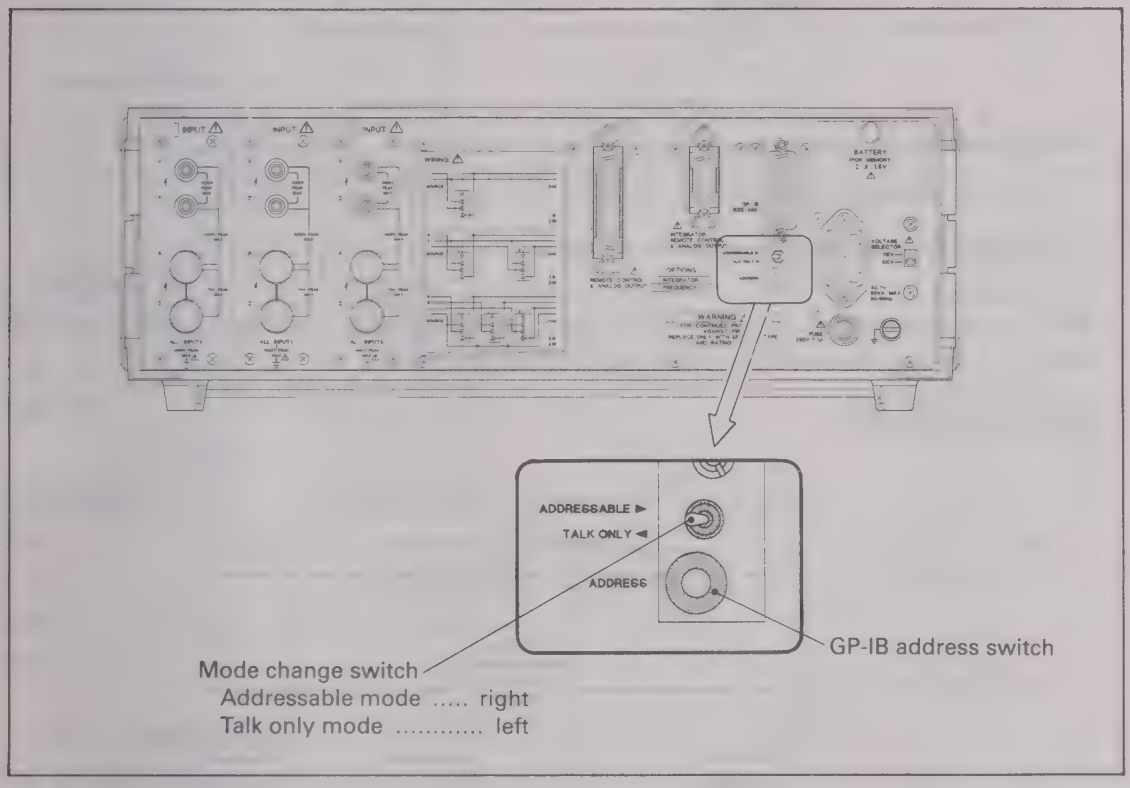
Syntax OI <terminator>

Comment
- After a time-out occurs, if an OI command is received, the integrated value is provided.
- Once integrated values are read, data is no longer read until the next time-out occurs.

3. TALKER FUNCTIONS

3-1. On Talker Functions

The talker functions are divided into ADDRESSABLE mode and TALK ONLY mode.
The mode is changed over by the mode change switch on the rear panel.



3-1-1. ADDRESSABLE Mode

In this mode, the address of the instrument can be designated and talker or listener can be selected. In this mode, a remote control (listener function) is available for range selection, function setting, etc. Data output, setting information output (talker function), etc. can be performed of course.

It is used for a system centered on GP-IB controller or a personal computer.

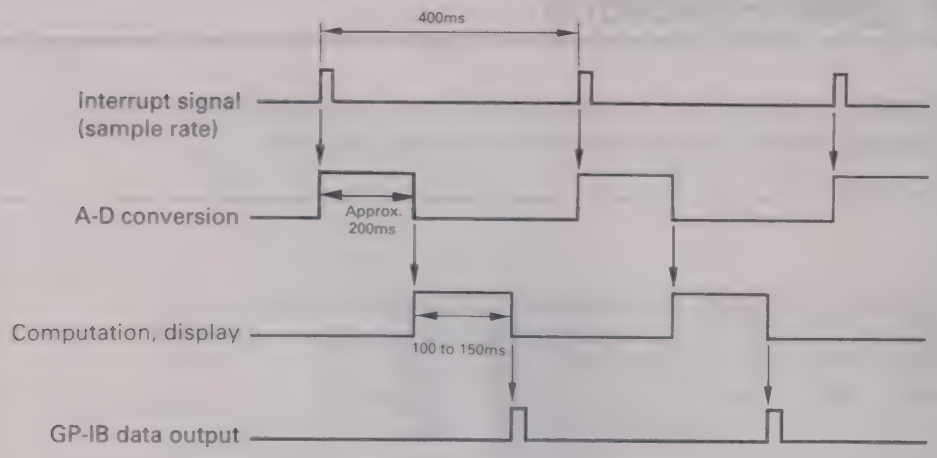
3-1-2. TALK ONLY mode

This mode is for a talker function only. Measured or computed data are output at 400 ms intervals when the sampling is at FREE RUN mode, or every time the TRIG key is pressed or an external A-D START signal is applied in sample hold mode.

GP-IB printer (listener function) or others are combined.

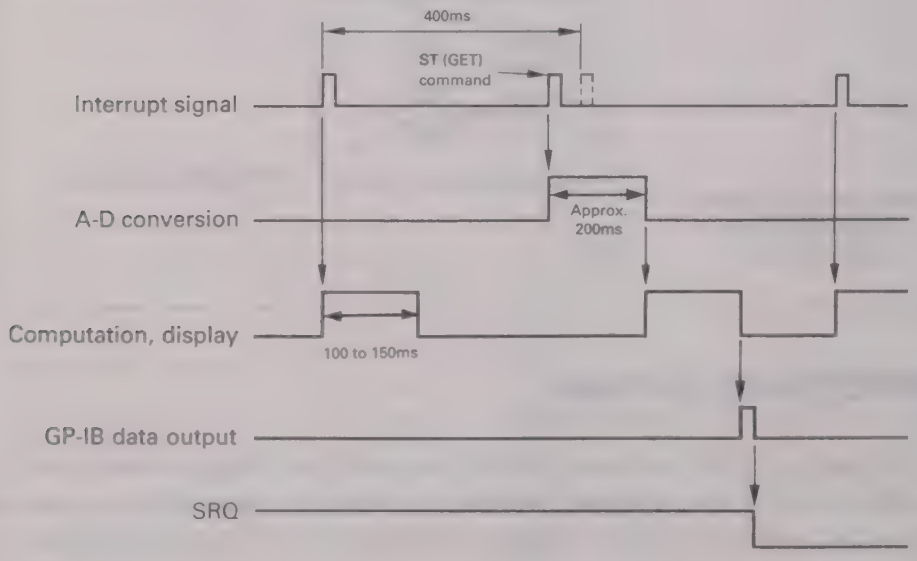
3-1-3. Timing chart

FREE RUN (sample hold OFF)



- With an internal interrupt signal of 400 ms cycle, A-D converter is activated, computation and display are carried out, and data are output to GP-IB interface.

Sample hold (HOLD)



- When ST or GET command is received, A-D converter is activated once, computation and display are performed, and data are output to GP-IB interface. At this time, SRQ of A-D END is generated. See page 2-12.
- Even if ST or GET command is not received, computation and display are performed with an internal interrupt signal of 400 ms. (Therefore, when the display mode (FUNCTION, ELEMENT) has been changed in sample hold mode, data which are available at present and ready to be displayed are dipslayed or, when they cannot be displayed, — — — — — — is displayed, thereby indicating data are absent.

3-2. Data Output Format

3-2-1. Output Format for measured/computed data

1 ····· 24	25	26 ····· 49	50	51 ····· 74	75	76
Data of DISPLAY A	,	Data of DISPLAY B	,	Data of DISPLAY C	C_R	L_F

<Data of DISPLAY A>

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
D	A	ℓ	Sp	E	A	m	n	u_1	u_2	u_3	.	p	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	E	p	e	.	→ DISPLAY B

FUNCTION
DA1: V
DA2: A
DA3: W

ELEMENT
EA1: 1
EA2: 2
EA3: 3
EA4: Σ

UNIT
V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)

Data status
O :computation overflow data
I : no measured data/overflow data
N : normal data

Digital data (value, Decimal point)
Polarity (Sp, −)
Mantissa part

Exponent (0, 3, 6)
Polarity (+, −)
Exponent part
E−3:10^{-3}(m)
E+0:1
E+3:10^{3} (k)
E+6:10^{6} (M)

Sp: space

<Data of DISPLAY B>

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
D	B	ℓ	Sp	E	B	m	n	u_1	u_2	u_3	.	p	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	E	p	e	.	→ DISPLAY C

FUNCTION
DB1: V
DB2: A
DB3: W
DB4: INTEG TIME

ELEMENT
EB1: 1
EB2: 2
EB3: 3
EB4: Σ

UNIT
V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)
H M Sp (Hour Minute)
INTEG TIME

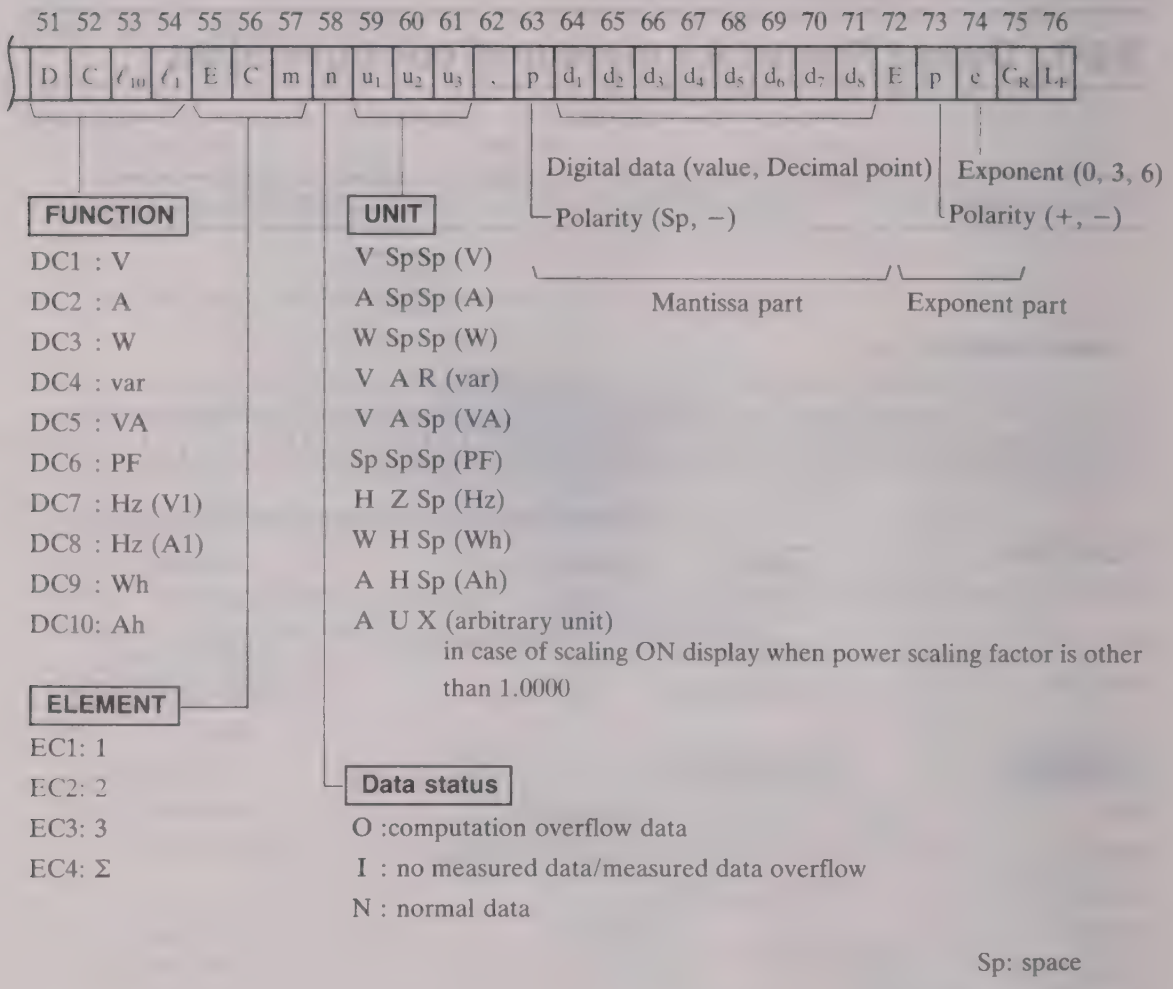
Data status
O :computation overflow data
I : no measured data/measured data overflow
N : normal data

Digital data (value, Decimal point)
Polarity (Sp, −)
Mantissa part

Exponent (0, 3, 6)
Polarity (+, −)
Exponent part

Sp: space

<Data of DISPLAY C>


51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76
D C ℓ10 ℓ1 E C m n u1 u2 u3 . p d1 d2 d3 d4 d5 d6 d7 d8 E p e CR LF
Digital data (value, Decimal point)
Exponent (0, 3, 6)
Polarity (Sp, −)
Polarity (+, −)
Mantissa part
Exponent part
FUNCTION
DC1 : V
DC2 : A
DC3 : W
DC4 : var
DC5 : VA
DC6 : PF
DC7 : Hz (V1)
DC8 : Hz (A1)
DC9 : Wh
DC10: Ah
ELEMENT
EC1: 1
EC2: 2
EC3: 3
EC4: Σ
UNIT
V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)
V A R (var)
V A Sp (VA)
Sp Sp Sp (PF)
H Z Sp (Hz)
W H Sp (Wh)
A H Sp (Ah)
A U X (arbitrary unit)
in case of scaling ON display when power scaling factor is other than 1.0000
Data status
O :computation overflow data
I : no measured data/measured data overflow
N : normal data
Sp: space

3-2-2. Setting information output format

When OL command is received, setting information is output.

(1)Transfer sequence

Line 1	Display FUNCTION setting	C_R	L_F
Line 2	Display ELEMENT setting	C_R	L_F
Line 3	Voltage range setting	C_R	L_F
Line 4	Current range setting	C_R	L_F
Line 5	Measurement mode setting	C_R	L_F
Line 6	Scaling factor setting	C_R	L_F
Line 7	Integration time setting	C_R	L_F

(2)Output format

• **Line 1** <display FUNCTION setting>

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
D	A	ℓ	Sp	;	D	B	m	Sp	;	D	C	n_{10}	n_1	C_R	L_F

DISPLAY A

DA1··· [V]
DA2··· [A]
DA3··· [W]

DISPLAY B

DB1··· [V]
DB2··· [A]
DB3··· [W]
DB4··· [INTEG TIME]

DISPLAY C

DC1··· [V]
DC2··· [A]
DC3··· [W]
DC4··· [var]
DC5··· [VA]
DC6··· [PF]
DC7··· [Hz] (V1)
DC8··· [Hz] (A1)
DC9··· [Wh]
DC10··· [Ah]

• **Line 2** <display ELEMENT setting>

1	2	3	4	5	6	7	8	9	10	11	12	13
E	A	ℓ	;	E	B	ℓ	;	E	C	ℓ	C_R	L_F

DISPLAY A **DISPLAY B** **DISPLAY C**

ℓ=1··· [1] , ℓ=2··· [2] , ℓ=3··· [3] , ℓ=4··· [Σ]

• **Line 3** <voltag range setting>

1	2	3	4	5	6	7	8	9
R	V	ℓ	;	A	V	m	C_R	L_F

RV4... 30V range
RV5... 60V range
RV6... 100V range
RV7... 150V range
RV8... 300V range
RV9... 600V range

AV0... fixed range mode
AV1.., automatic range setting mode

• **Line 4** <current range setting>

1	2	3	4	5	6	7	8	9
R	A	ℓ	:	A	A	m	C_R	L_F

RA4... 0.5A range
RA5... 1 A range
RA6... 2 A range
RA7... 5 A range
RA8... 10 A range
RA9... 20 A range

AA0... fixed range mode
AA1... automatic range setting mode

• **Line 5** <measurement mode setting>

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
D	S	ℓ_1	:	W	R	ℓ_2	:	M	N	ℓ_3	:	F	L	ℓ_4	:	A	G	ℓ_5	:	S	C	ℓ_6	:	H	D	ℓ_7	C_R	L_F

ℓ_1 to ℓ_7 :0 or 1

DS0: EOI generated on last line only
DS1: EOI generated on each line

WR0: three-phase three-wire wiring
WR1: three-phase four-wire wiring

MN0: rms measurement/display
MN1: mean value rectification measurement, rms calibration display

FL0: FILTER FAST
FL1: FILTER SLOW

AG0: averaging OFF
AG1: averaging ON

SC0: scaling OFF display
SC1: scaling ON display

HD0: sample free run status
HD1: sample hold status

• **Line 6** <scaling factor setting>

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
K	V	v_1	v_2	v_3	v_4	v_5	v_6	:	K	A	a_1	a_2	a_3	a_4	a_5	a_6	:	K	W	w_1	w_2	w_3	w_4	w_5	w_6	C_R	L_F

Voltage scaling factor
Current scaling factor
Power scaling factor

Each factor...0.0001 to 10000. (6 characters including Decimal point)

• **Line 7** <integration time setting>

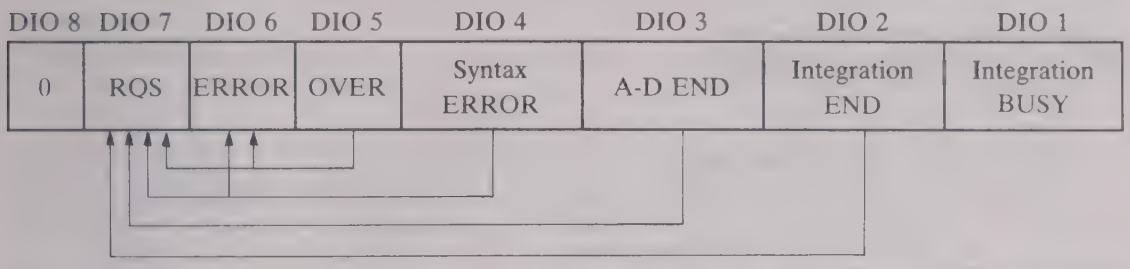
1	2	3	4	5	6	7	8	9
T	M	h_{100}	h_{10}	h_1	m_0	m_1	C_R	L_F

Hour Minute

Integration time... manual mode : 00000
Timer mode : 00001 to 10000
(1 min to 100 h)

3-2-3. Status byte output format

The output format of status byte sent by serial poll is as follows.



(1)RQS (DIO 7)

Becomes "1" when any of interrupt causes (OVER, syntax ERROR, A-D END, integration END) of a status byte designated by IM command has been produced, whereby SRQ goes True and an interrupt to a controller is generated.

It cannot be overridden by IM command.

When bits (3) to (6) have become "1", RQS (DIO 7) changes to "1", and SRQ is generated. Note that, when not designated by IM command, the bits do not become "1" even if the output conditions are satisfied.

(2)ERROR (DIO 6)

Becomes "1", thereby turning RQS True when any of the interrupt causes (OVER, syntax ERROR) of a status byte designated by IM command has been produced.

(3)OVER (DIO 5)

Becomes "1" when measured data causes range overflow, peak overflow or computation overflow or when measured data are absent.

RQS (DIO 7) and ERROR (DIO 6) also become "1".

Ineffective when not designated as an interrupt cause by IM command.

Details of the error at this time can be checked by OE command.

(4)Syntax ERROR (DIO 4)

A syntax error occurs when GP-IB command received is not defined, the parameter is beyond a specified range or the command cannot be executed because of a status of the mainframe.

Details of the error at this time can be checked by OE command.

(5)A-D END (DIO 3)

Becomes "1" as soon as the measurement ends by entry of TRIG key on the front panel or input of GP-IB command or remote A-D START when the instrument is at a sample hold status.

Details of the error at this time can be checked by OE command.

(6)Integration END (DIO 2)

Becomes "1" when the integration has timed-out in the timer mode of integrating function or the display has overflowed in a manual mode.

(7)Integration BUSY (DIO 1)

"1" when an integration is in progress, or "0" when stopped.

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5. SCHEMATIC DIAGRAM AND ELECTRONIC PARTS LIST

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	GP-IB Ass'y Electronic Parts List		—	5–4

NOTES

1. Components — especially ICs — which are equivalent to components shown in the schematic diagrams and parts list, but manufactured by other manufacturers, can in general be used in the instrument.
2. Subject to change without notice; changes may be made to improve the instrument's performance.

INDEX

List of abbreviations

ac	=	alternating current
Ag	=	silver (ed)
Al	=	aluminum
amp	=	amplifier
ass'y	=	assembly
Au	=	gold
car film	=	carbon film
cap	=	capacitor
cct	=	circuit
cer	=	ceramic
coef	=	coefficient
com	=	common
comp	=	composition
conn	=	connector
dc	=	direct current
dia	=	diameter
elect	=	electrolytic
FET	=	field effect transistor
film	=	film
fxd	=	fixed
Ge		germanium
gnd		ground
IC		integrated circuit
JIS		Japanese Industrial Standard
L	=	inductor
met	=	metal (lized)
mfr	=	manufacturer
Ne	=	neon
nom val	=	nominal value
OSC		oscillator
pwb	=	printed wiring board
pcb	=	printed circuit board
plstc	=	plastic
polye	=	polyester
polys		polystyrene
pot		potentiometer
prec	=	precision (temperature coefficient, long term stability, and/or tolerance)
res	=	resistor
rng	=	range
rtry	=	rotary
Se	=	selenium
sect	=	section(s)
S	=	silicon
sub-ass'y	=	sub-assembly
sw	=	switch
sys	=	system
sply	=	supply
Ta	=	tantalum
temp	=	temperature
trim	=	trimmer
TSTR	=	transistor
trans	=	transformer
var	=	variable
ww	=	wire wound
YEW spec	=	special specification of Yokogawa Electric Works, Ltd. - YEW.

† Request the item marked with † to YEW.

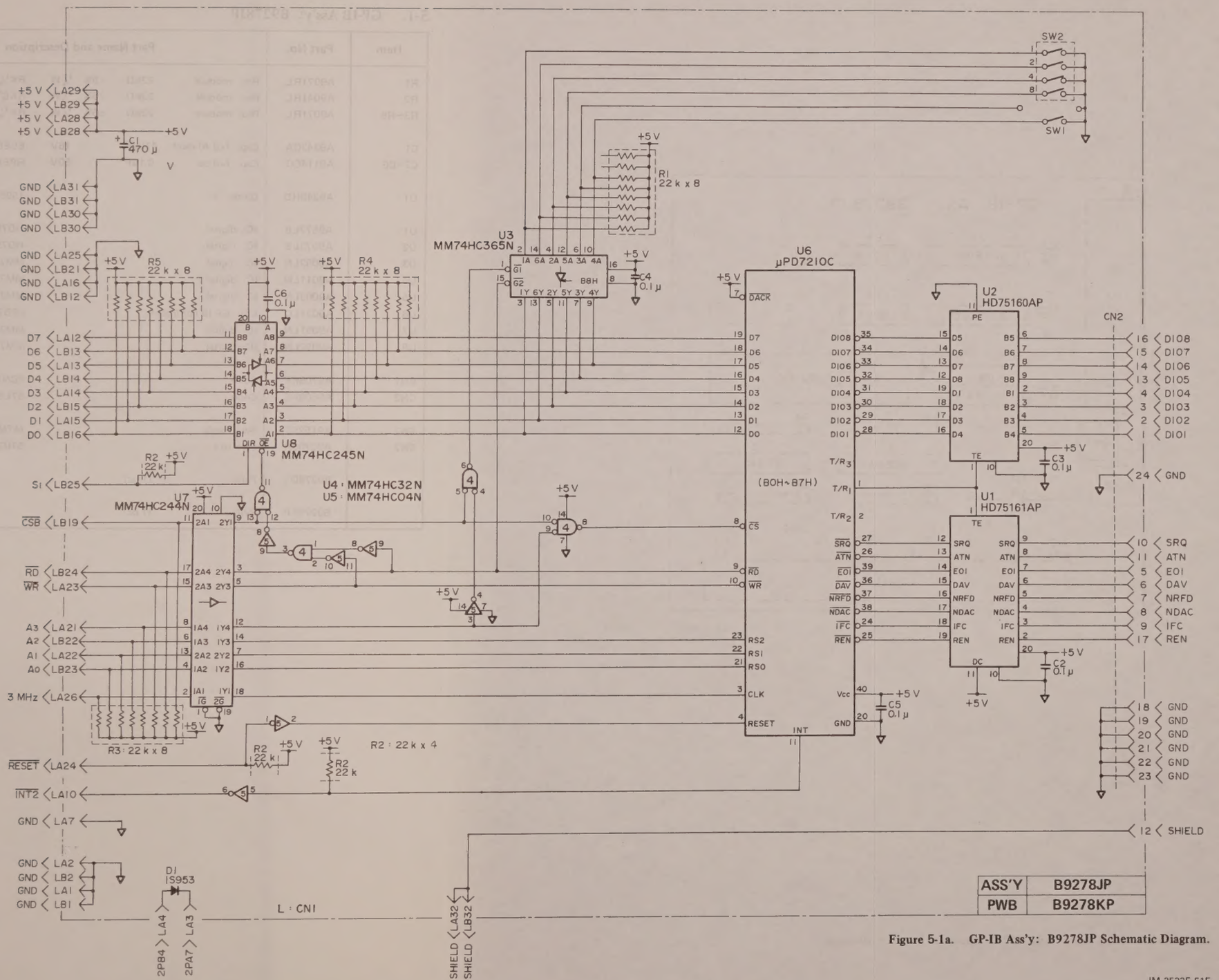
†† Replace the item marked with †† as a complete part set even when one of its parts is damaged. Request the complete part set to YEW.

††† Replace the item marked with ††† as an assembly even when a part of it is damaged. Request the assembly to YEW.

· · · · — Optimum value selected at factory, average value shown (part may be omitted).

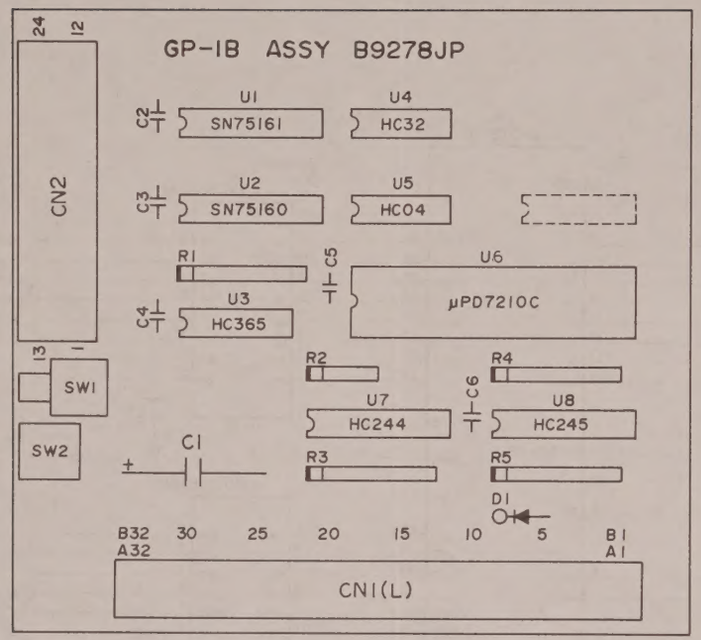
Example

Conn : multi = multi connector
Cap : fxd Al elect = Fixed aluminum electrolytic capacitor
Cap : fxd met polye film = Fixed metallized polyester film capacitor
PCB Ass'y = Printed circuit board assembly
Res : fxd car film = Fixed carbon film resistor
Res : var ww = Wirewound variable resistor
Temp coef = Temperature coefficient



(July 1992)

Figure 5-1a. GP-IB Ass'y: B9278JP Schematic Diagram.



(July 1992)

Figure 5-1b. GP-IB Ass'y: B9278JP Components Location Diagram.

5-1. GP-IB Ass'y: B9278JP.

(July 1992)

Item	Part No.	Part Name and Description	Remarks
R1	A9071RL	Res: module 22kΩ ±5% 1/8W RK1/8 B8 22kΩJ	8 elements
R2	A9041RL	Res: module 22kΩ ±5% 1/8W RKC1/8 B4 22kΩJ	4 elements
R3~R5	A9071RL	Res: module 22kΩ ±5% 1/8W RK1/8 B8 22kΩJ	8 elements
C1	A9343CA	Cap: fxd Al elect 470μF 16V ECEB1CS471R	
C2~C6	A9114CC	Cap: fxd cer 0.1μF 50V RPE132-305F104Z50	
D1	A9248HD	Diode: Si 1S953	
U1	A9572LB	IC: digital HD75161AP	
U2	A9573LB	IC: digital HD75160AP	
U3	A9062LN	IC: digital MM74HC365N	CNOS
U4	A9011LN	IC: digital MM74HC32N	CNOS
U5	A9003LN	IC: digital MM74HC04N	CNOS
U6	A9031LC	LSI: GP-IB controller μPD7210C	
U7	A9051LN	IC: digital MM74HC244N	CMOS
U8	A9052LN	IC: digital MM74HC245N	CMOS
CN1	A9708KP	Conn. PCN10A-64P-2.54DS	64P
CN2	A9608KC	Conn. 57LE-20240-77C0-D35G	24P
SW1	A9152SS	Sw: toggle MTM106D-V	
SW2	A9370SR	Sw: rtry S1031	
	B9278DY	Plate (1 pc)	
	B9278KP	PWB (1 pc)	

YOKOGAWA ◆

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